Environmental Management

Introduction

As part of analyzing the existing conditions within the community the following assessment of Columbia's built and natural environment has been prepared. This Columbia Imagined theme looks at what plans, programs, policies and regulations exist to enhance, preserve, and protect the limited environmental and natural resources within and around Columbia. Environmental management includes, but is not limited to including: natural (and some cultural) resources and best practices such as soil conservation, tree preservation, storm water management, stream buffers, flood plains, parks, open spaces, protection/promotion of scenic areas, water quality, watershed management, historic preservation, wildlife corridors, and invasive species. Besides adding beauty and character to the landscape, natural resources perform a number of ecological services. For example, mature trees moderate extremes of temperature, transpire oxygen into the atmosphere, and stabilize soil; wetlands filter waterborne pollutants, provide groundwater recharge, and reduce flooding.

The assessment that follows provides an overview of the physical characteristics of the land and waterways contained within the Columbia Imagined study area and draws upon the inventory of environmental resources identified within the City's Natural Resources Inventory (NRI) report completed in 2010. The findings of the NRI rely on 2007 land coverage imagery which categorized land coverage within the study area and identified the existing natural resources. The NRI's findings are utilized as a baseline for monitoring future changes to the landscape.[i]

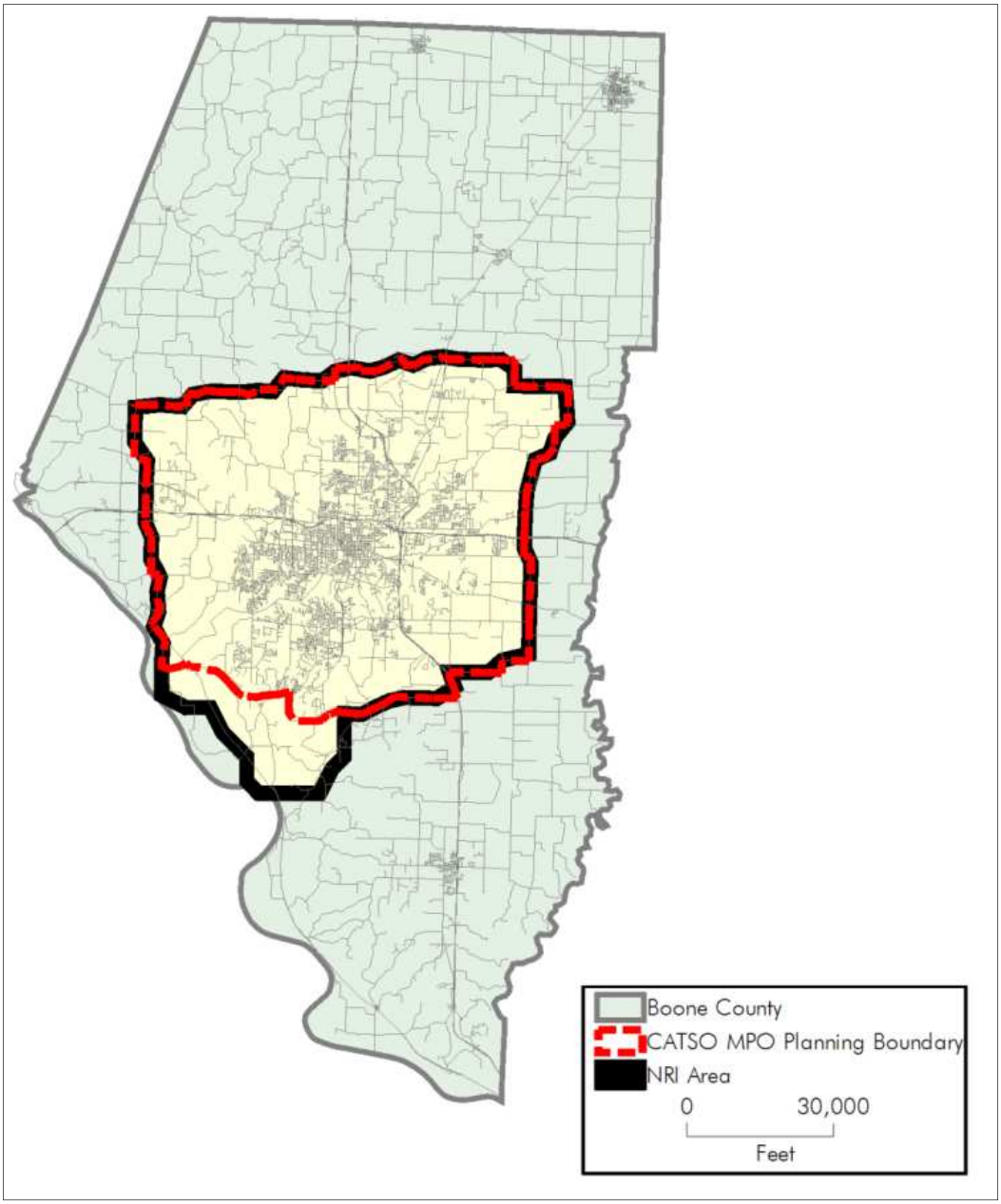
A goal of Columbia Imagined is to incorporate best management practices of planning and sustainability into its future land use planning and policy recommendations. Understanding where the City is currently will help in formulating better strategies for where the City wants and should be in the future.

Natural Resource Inventory (NRI)

Map 2-xx illustrates the NRI study area. This area covers approximately 198 square miles in and around Columbia. Of this total, 180 square miles is located within the Columbia Imagined study area. The 180 square miles is defined as the Metropolitan Planning Area by the Columbia Area Transportation Study Organization (CATSO), the federally designated Metropolitan Planning Organization (MPO) for Columbia and Boone County. The remaining 18 square miles is located to the southwest of the MPO boundary where the City has recently annexed property. All or very minimal portions of 46 different waterways are within the NRI area.

The land cover for the NRI was produced from analysis of high resolution multi-spectral photography collected by the University of Missouri's Geographic Resource Center. This imagery was then verified by field surveys and resulted in the land cover within the NRI study area to be classified into six different classes. These classes included tree canopy, cropland, urban/impervious, water, disturbed/barren, and grassland. More detailed definitions of these classifications can be found within the NRI report which is available at: xxxxxxxx.

Map 2-xx - NRI Study Area

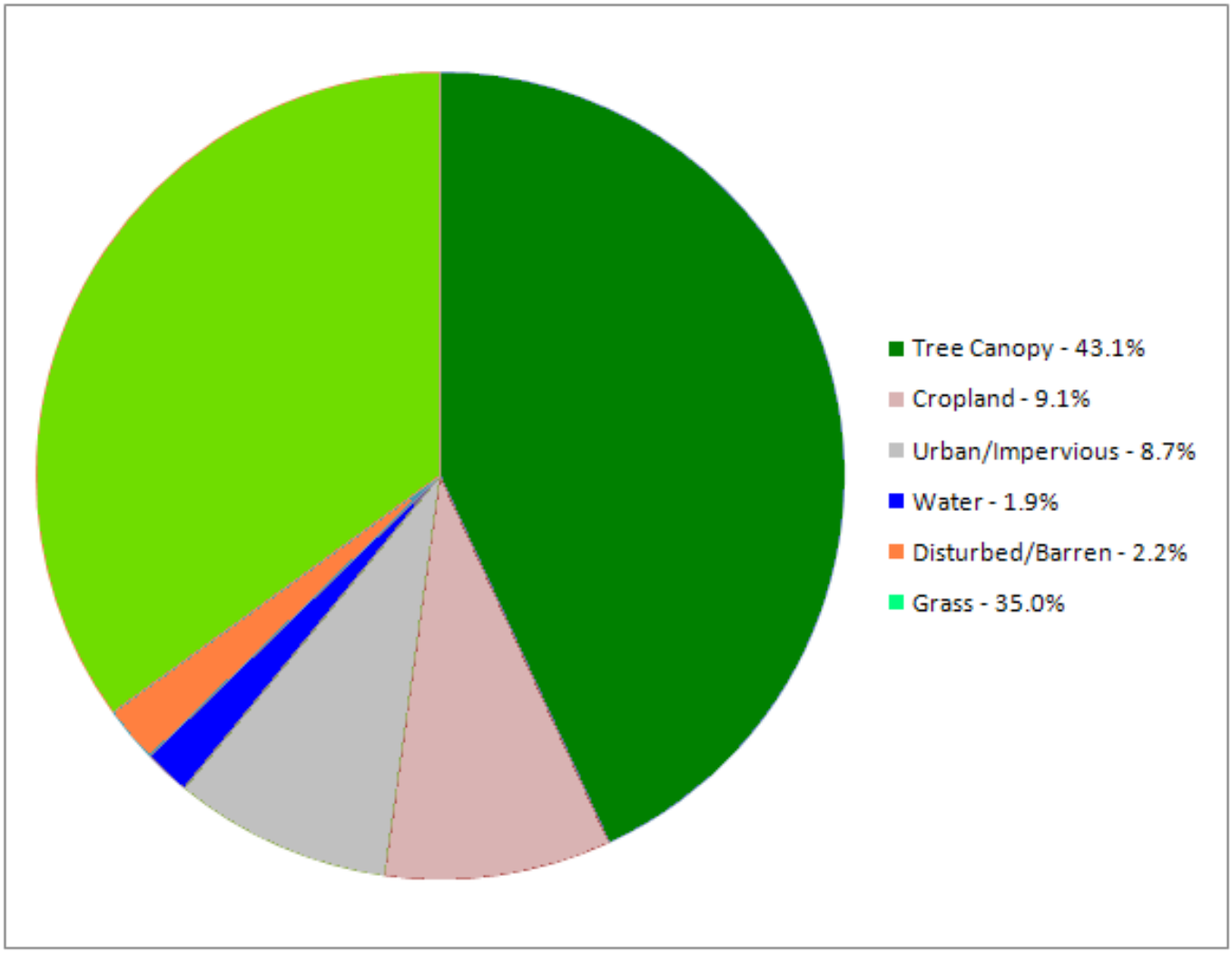


Source: City of Columbia NRI

Based upon these classifications, land coverage within the NRI study area is distributed as shown in Figure 2-xx. As can be seen the majority, 43%, of the existing land coverage is considered to be occupied by "tree canopy". This classification means that at least 60% of the area is covered by tree canopy. As of this writing, a full forest analysis was being completed to determine the types of trees that are found within this acreage.

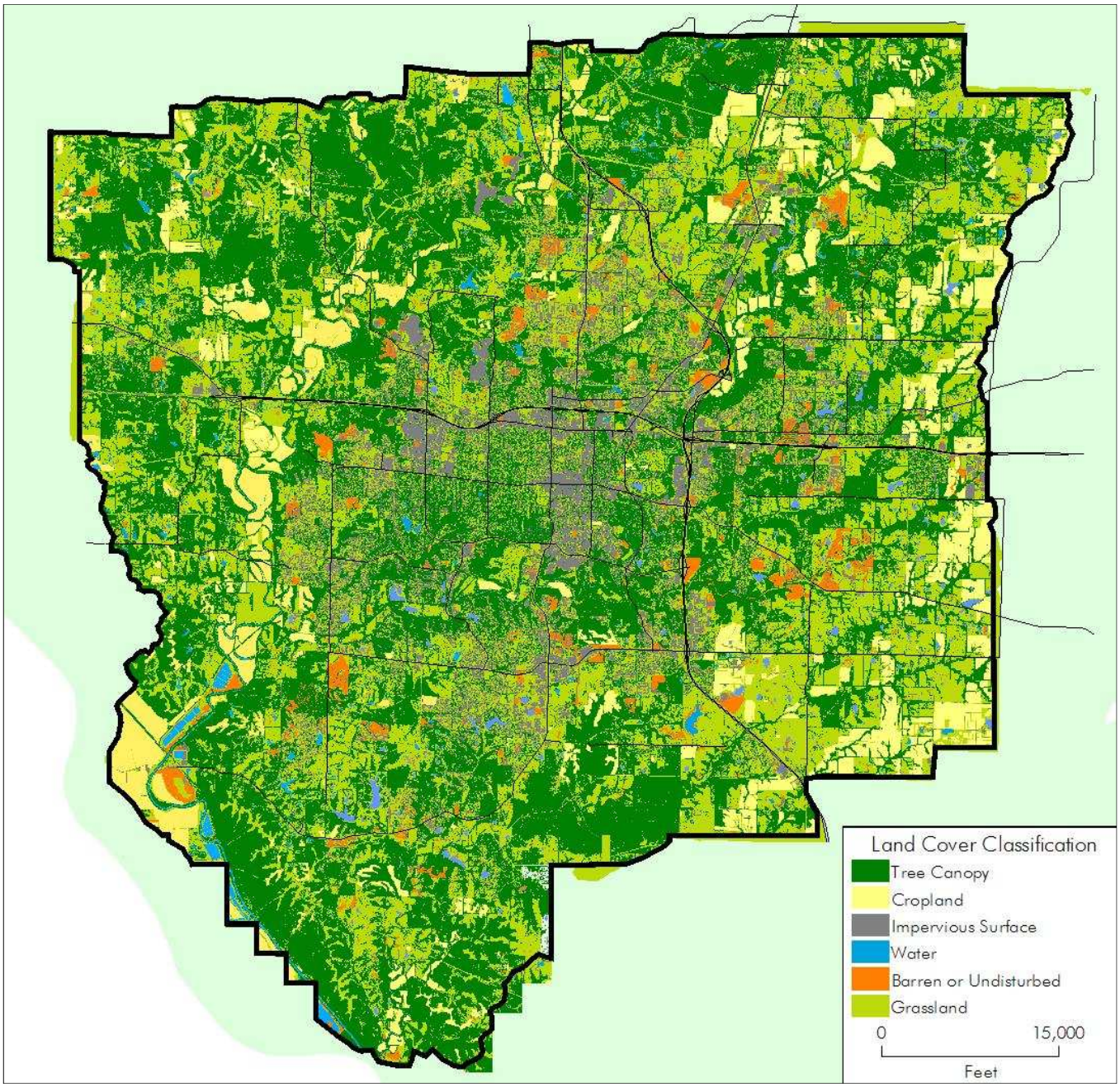
Map 2-xx shows graphically the land coverage within the NRI study area.

Figure 2-XX - Land Cover Classification Distribution



Source: City of Columbia NRI

Map 2-XX - Natural Resource Inventory (NRI) Land Cover



Source: City of Columbia NRI

As the above maps and figures have displayed, the NRI report is a significant resource for understanding what the existing conditions are within and around Columbia. While these illustrations have focused primarily on how land has been consumed the NRI offers other valuable data and insights. The following sections and subsections will explore what development limitations exist in the study area as related to the environmental assets and features contained within the NRI.

Limitations to Development

The preceding sections have shown there are several limitations to development in the study area. The limitations can be summarized into the three general categories shown below:

- Physical - Steep slopes, karst topology, sinkholes, soil conditions, etc.,
- Regulatory - Zoning and subdivision, floodplain, stormwater, land disturbance, tree preservation, etc.; and
- Utilities - Centralized sewer service, public water available at sufficient rates of flow, electric service, etc.

Map 2-xx illustrates the inter-relationship of these three types of limitations on the potential for development within the study area. Table 2-xx provides the acreage totals, the total percent of the NRI area affected, and the percentage of type of development limitation relative to the total area.

Understanding the impacts that these limitations have on the future development is important because poorly managing these limited environmental features will result in their loss for future generations. Developing, enhancing, and implementing environmental management policies and procedures will ensure that the value these features add to the study area are preserved and that one of the overall goals of creating a new land use plan for Columbia's future growth and development is fulfilled.

Table 2-xx - Limitations to Development by Type and Acreage

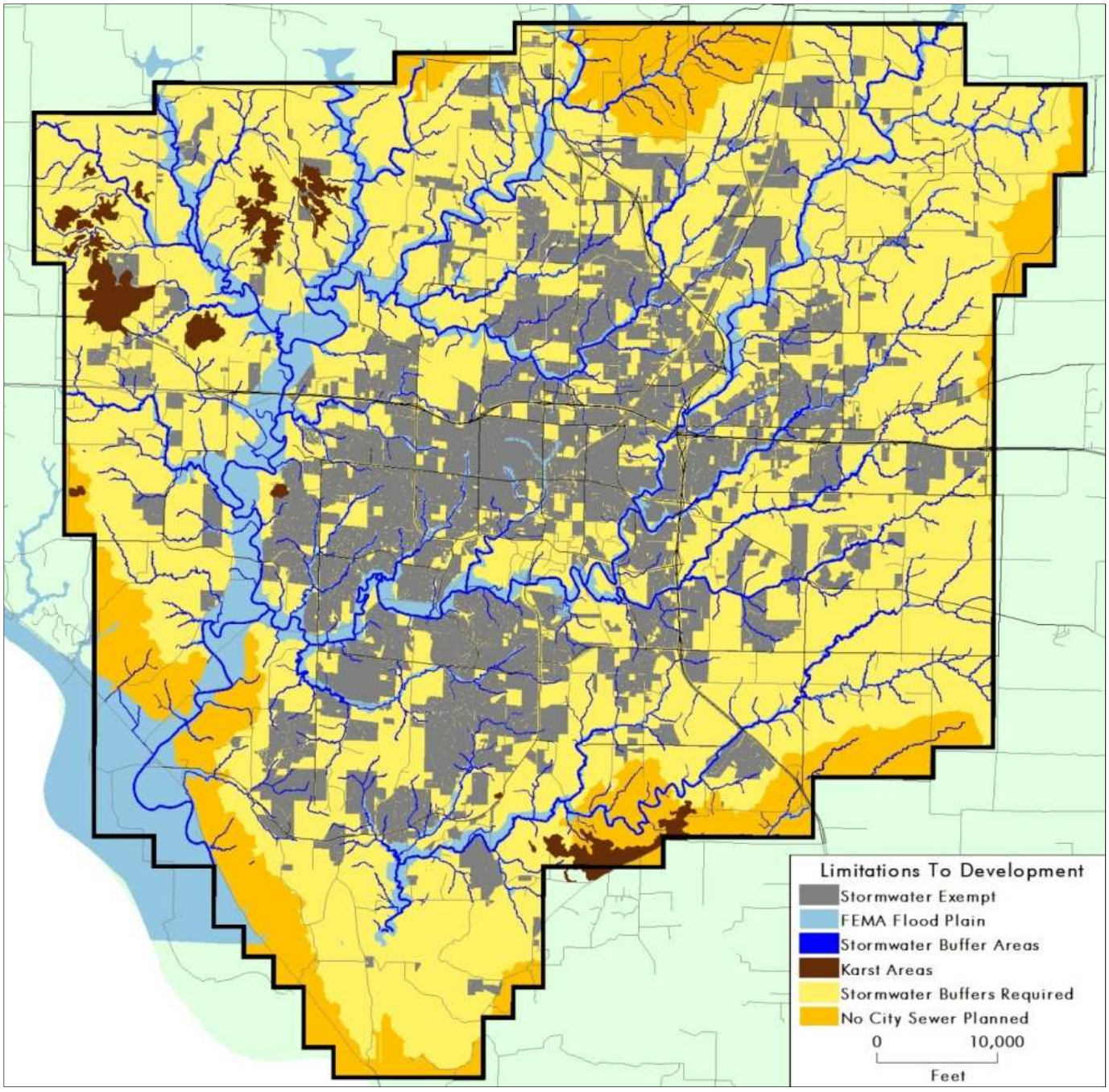
Developmental Constraint Acreage by Type	Acreage	% by Type	% of NRI Area
No City of Columbia Sewer Service	20,260.3	42.5%	16.0%
100 Year Flood Plain	14,737.0	30.9%	11.6%
Landscape: Slope greater than 10 percent	11,309.8	23.7%	8.9%
Stormwater Buffers	1419.7	3.0%	1.1%

Source: City of Columbia Public Works and NRI data

Watersheds

Watersheds are defined in the City Code as "all the land area which drains to a given body of water". Watershed boundaries are defined by high points and ridges from which gravity moves water from surface runoff to common collection points via drainages, catchments, and sub-watersheds. Each watershed is named after the stream, creek, or river to which it flows. Map 2-xx shows the six watersheds that the study area is drained into. These watersheds are Bonne Femme Creek, Little Bonne Femme Creek, Hinkson Creek, Rocky Fork, and Callahan Creek which flow into Perche Creek and ultimately drains to the Missouri River.

Map 2-xx - Limitations to Development

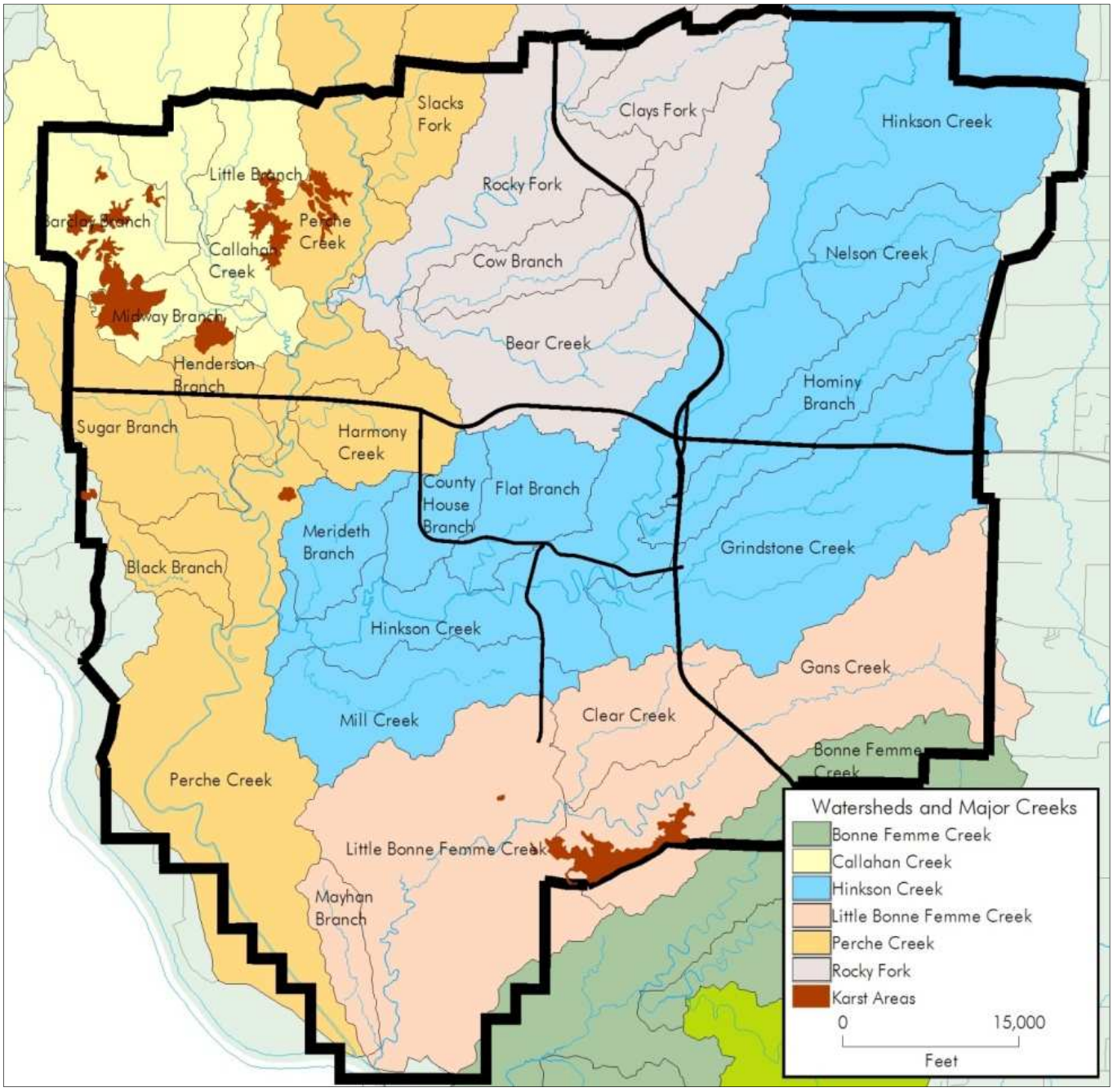


Source: City of Columbia Public Works and NRI data

Streams

As noted above, each watershed is named after the stream, creek, or river that it flows into. Streams are bodies of moving water confined by banks, which may include small rivers or large creeks[ii]. Streams and stream corridors act as natural filtration systems for groundwater and support a wide variety of wildlife by providing habitat for both aquatic and land animals.

Map 2-XX - Watershed Boundaries & Major Streams



Source: City of Columbia NRI

There are three types of streams defined within the City's regulations.

1. Perennial (Type 1): Perennial streams have well-defined channels that contain water year round.
2. Intermittent (Type 2): Intermittent streams have well-defined channels that contain water for only part of the year.
3. Ephemeral (Type 3): Ephemeral streams may or may not have a well-defined channel, and carry only water resulting directly from precipitation events.

The study area is traversed by 20 named perennial streams. The major streams within the study area are shown on Map 2-xx.

Agricultural Land

Nearly half of the Columbia Imagined study area is categorized as grassland or cropland according to the NRI. Cropland is primarily concentrated along the east, west, and northeast edges of the city, and constitutes approximately 9% of the total study area. Much of the cropland located on the east side of Highway 63 is considered prime farmland, assuming appropriate drainage, which is defined as "land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses."[iii]

Of the remaining land in the study area – excluding developed areas, stream corridors, and steep slopes – a substantial portion is considered "farmland of statewide importance." These lands are not as well-suited for crop production as prime farmland, but could potentially be treated to economically produce high yields of crops.[iv] Within the study area, farmland of statewide importance appears to be used primarily for hay production.

Map 2-xx shows these areas graphically.

Tree Cover

Approximately 43% percent of the study area is covered by trees. Most of this tree cover is situated on moderate to steep slopes (i.e., greater than 6%), which are primarily creek banks. The City requires 25% of climax forest to be preserved on tracts of one acre or more. The County has no specific tree preservation ordinance. A climax forests occur when a forest has progressed through early succession of "pioneer" species to a point where it is dominated by tree species primarily consisting of oak, hickory, and other shade-tolerant hardwoods, and this mixture of species remains relatively constant for an extended period of time – often hundreds of years.[v]

Trees contribute numerous and significant environmental services:

- Creating habitat for wildlife
- Absorbing airborne toxins
- Providing fuel, pulp, and wood
- Producing oxygen through photosynthesis
- Stabilizing slopes and stream banks
- Facilitating soil formation and nutrient cycling
- Providing recreational opportunities
- Filtering storm water and sequestering carbon

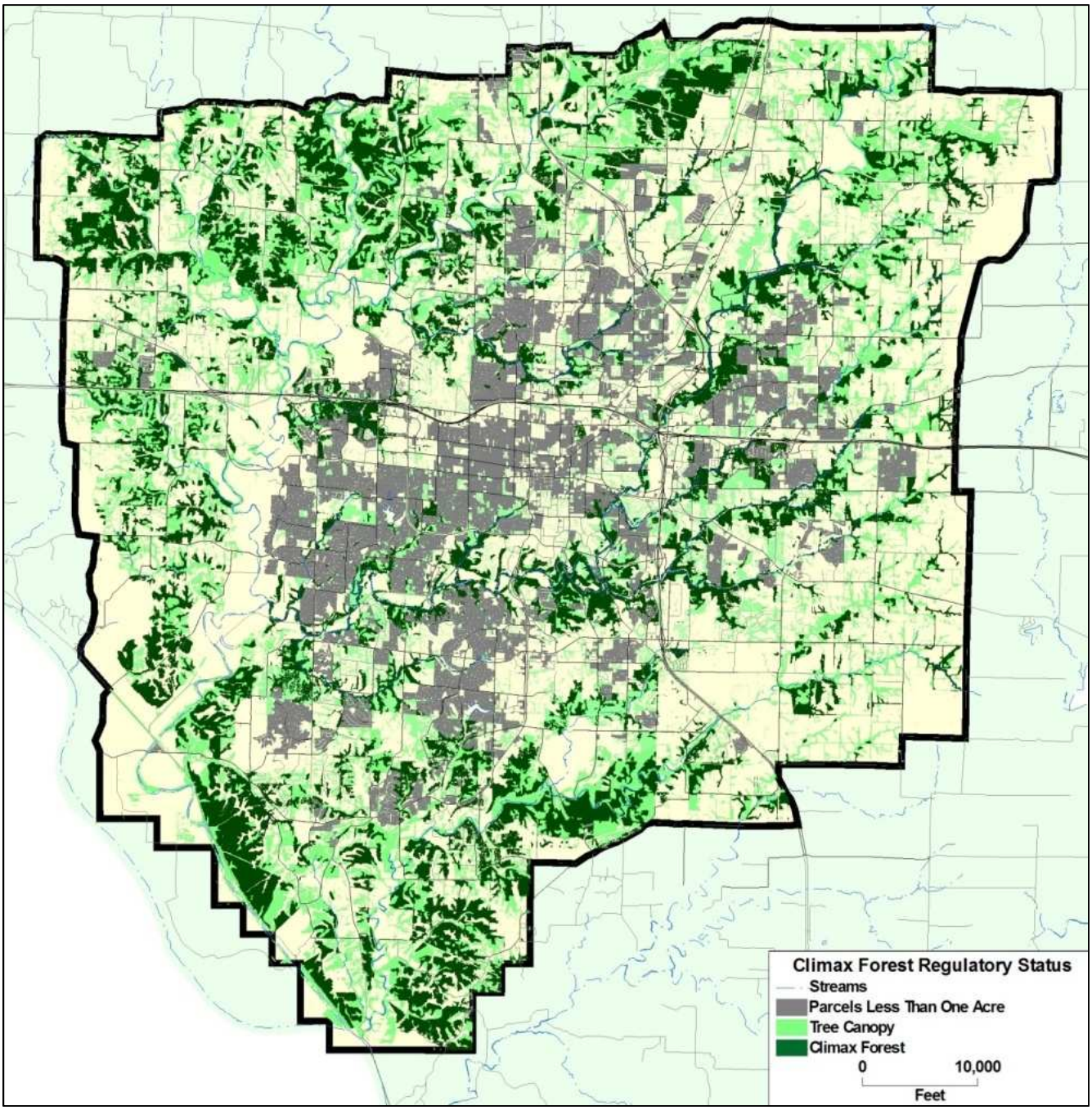
The NRI provides an overview of the geographic distribution of tree cover within the Columbia Imagined study area which has been classified into 11 tree associations. The pattern that emerges is one of roughly concentric belts. "Urban forest/landscape planting" and "Mixed invasive forests" are predominant within the "inner ring of I-70/Stadium/US 63; Young and old Oak-Hickory forest and young and old bottom land forests exists in large stands in the remaining areas to the City limits.[vi]

Map 2-xx - Prime Farmland

Source: University of Missouri CARES

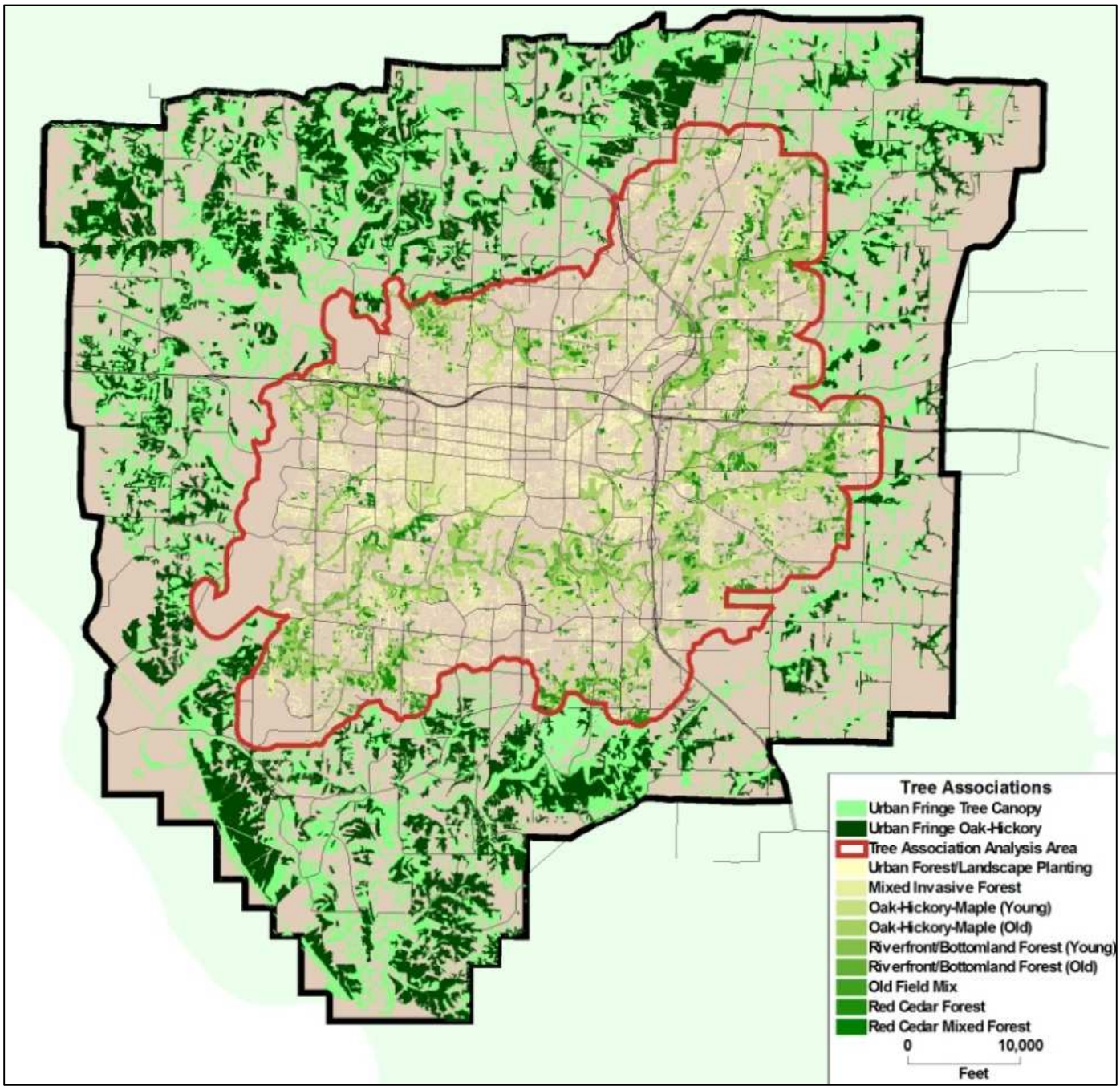
Maps 2-xx and 2-xx show the various treed areas subject to preservation and the association of treed areas to land cover, respectively.

Map 2-xx Climax Forest Regulatory Status



Source: City of Columbia NRI

Map 2-xx - Tree Associations



Source: City of Columbia NRI

Sensitive Features and Conditions

While the landscape of the study area is primarily composed of flat to gently sloping farm and grass lands, it also contains a variety of features that are particularly sensitive to development activities and impacts. Sensitive landscape features and characteristics are considered as those that, when disturbed, might lead to hazardous conditions (i.e., safety issues) or environmental degradation problems (e.g., erosion and pollution). Three typical features and conditions that are classified as sensitive areas include karst topography, erodible soils, and steep slopes.

Maps 2-xx illustrates these types of areas within the study area.

Karst Topography

Karst topography results from acidified rainwater infiltrating cracks and fissures in limestone bedrock and slowly dissolving the rock to create large voids. Sinkholes result when these underground caverns collapse and create surface depressions. A prime example of a karst feature in Boone County is Devil's Icebox Cave in Rockbridge State Park. There is no known karst topography in the study area.

Highly Erodible Soils

Highly erodible soils are the result of a combination of factors, which may include intense rainfall, steep slopes (particularly those greater than 10% percent and situated in major drainage areas), length of slopes, vegetation cover, and the physical and chemical properties of the soil. Certain soil types such as loess tend to erode more easily than others. Highly erodible soils generally coincide with steep slopes, which parallel the major creeks that flow through the study area. Highly erodible soils and steep slopes have associated impacts that make their disturbance hazardous to plants, wildlife, and human activities if they are not properly managed.

Maps 2-xx illustrates highly erodible land within the study area.

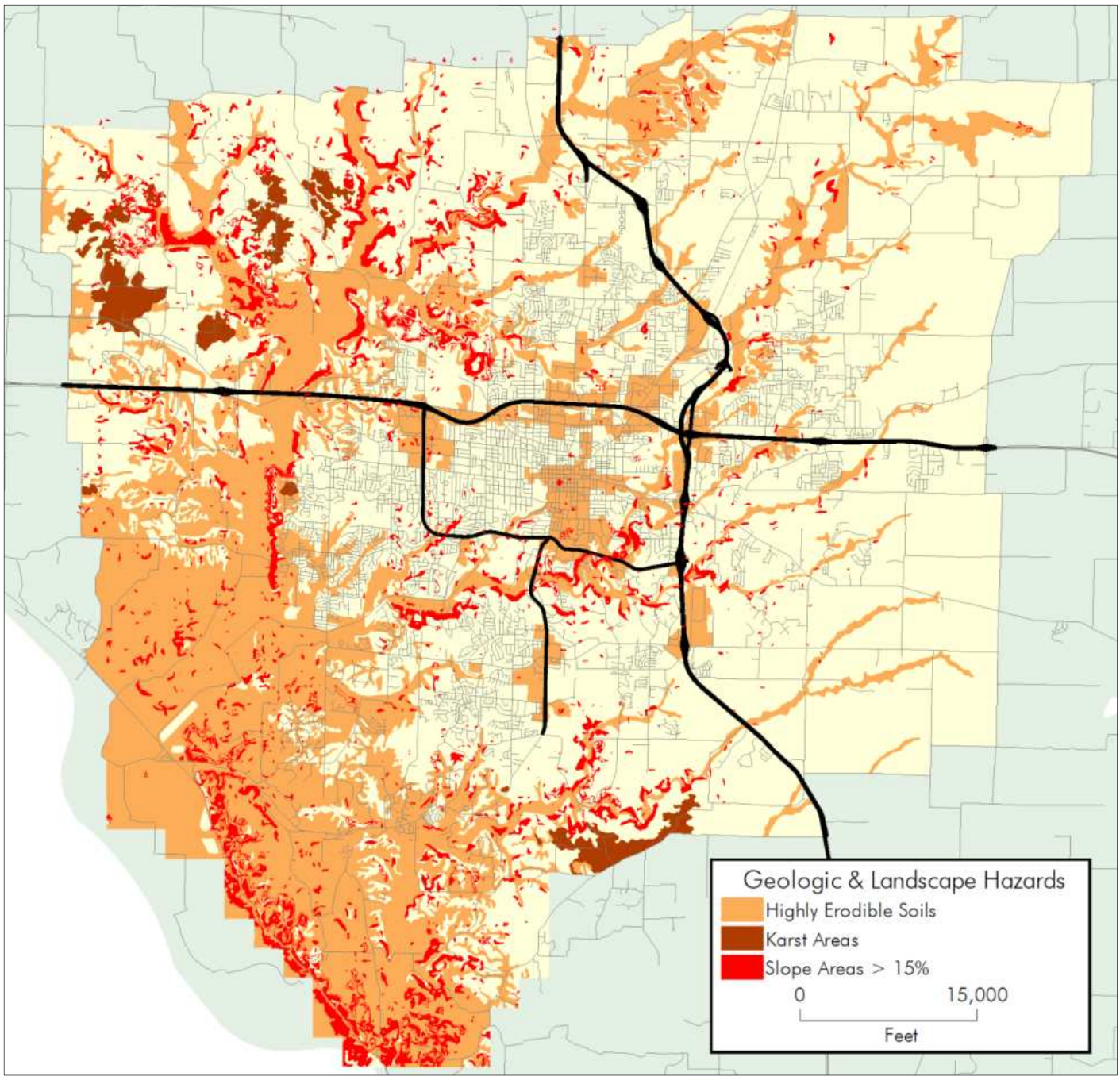
Steep Slopes

Typically, slopes of 15 percent are considered "steep". Slopes are considered moderate when between 8-10 percent. Slopes in this moderate range are the maximum allowable for local roadway construction. Percent slope refers to the ratio of vertical change in elevation and horizontal distance, (i.e., 15 foot increase in elevation across 100 feet of distance = 15% slope.)

Steep slopes commonly occur adjacent to creek cut banks and in association with stream buffers and floodplains, which are protected by existing City and County regulations that deter development of such areas. Steep slopes often coincide and contribute to highly erodible soil conditions. Under normal conditions, where these areas remain undisturbed, they are not typically considered to be highly erosive. However, areas that have recently been cleared for development purposes are an exception.

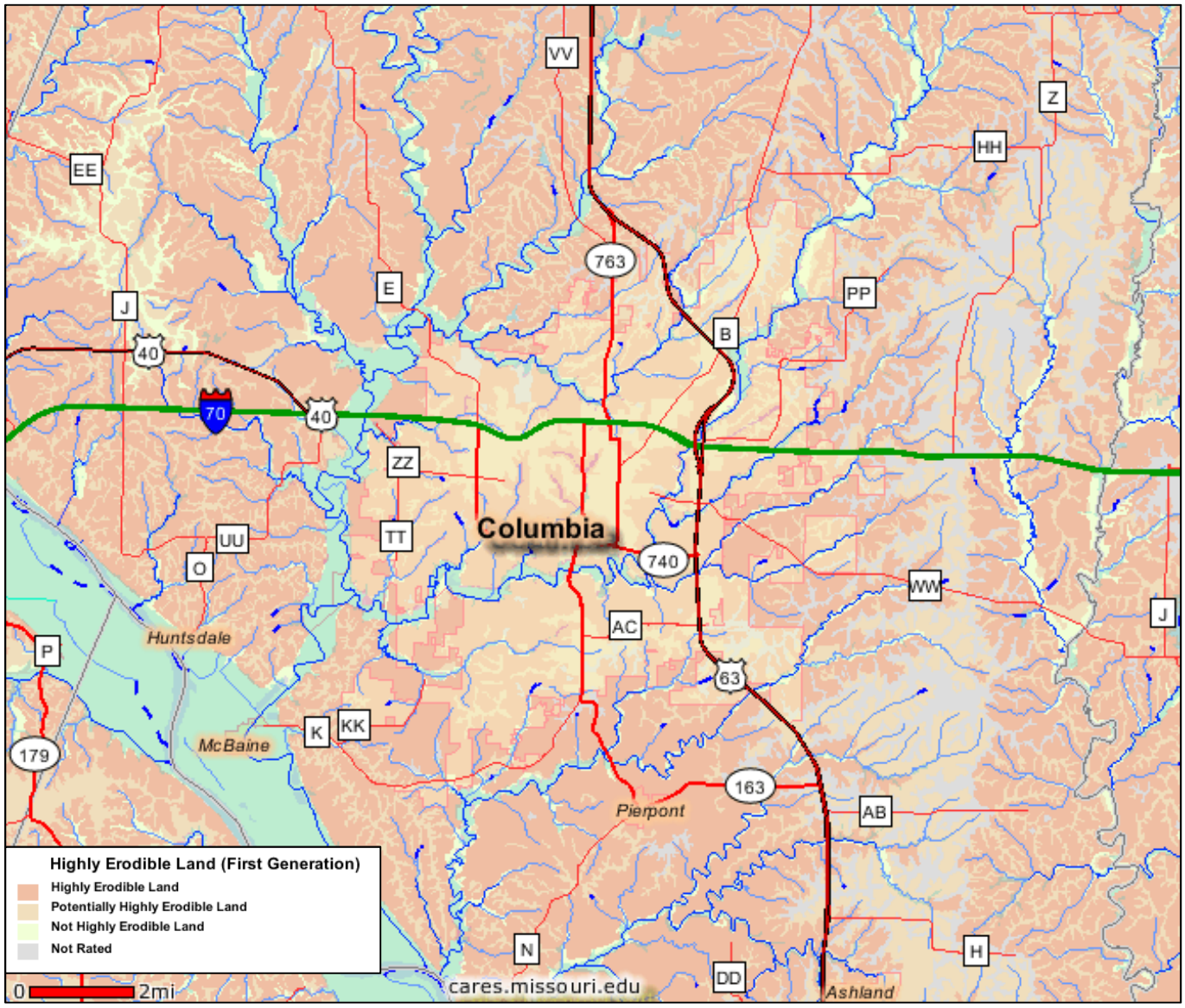
Maps 2-xx shows slopes greater than 15% within the study area.

Map 2-xx - Vulnerable Landscape Areas



Source: Boone County Soil Survey and NRI data

Map 2-xx – Highly Erodible Land



Source: University of Missouri CARES

Ordinances, regulations, and policies

As a means of protecting the natural resources identified above, the City has adopted a collection of ordinances, regulations, and policies designed to minimize the impacts that development can bring upon these resources. Many of the existing regulations were adopted to ensure compliance with either State or Federal mandates. Others were implemented based on best practices to ensure that certain environmental features were not unnecessarily removed or compromised as development progresses. In either case, the effect of the regulations has been to ensure that the limited natural resources within the community are retained for future generations.

The following subsections provide a brief explanation of what the existing ordinance, regulation, or policy does to protect the environmental resources within the study area.

Floodplains

City and County floodplain regulations restrict development activity within the 100 year floodplain. Limited development may occur inside the 100 year floodplain subject to the issuance of a floodplain development permit. Applicants within the City limits must show that foundations of proposed residential structures in the floodplain will be elevated at least two feet above the 100 year flood event level. Special construction techniques may be employed for commercial structures, as an alternative to the two-foot elevation requirement, to allow flood waters to pass through the structure (e.g., flood doors). All structures built in the floodplain must be anchored and engineered to withstand the forces of floodwater currents.

Building permits for structures in the floodway may be approved subject to the completion of engineering studies that prove the activity will not result in an increase in flood water levels upstream (i.e., "no-rise" certificate). Map 2-xx shows the FEMA 100-year Flood Hazard Areas in the study area.

Map 2-xx - FEMA "100 Year" Flood Hazard Areas

Source: City of Columbia NRI

Stormwater

The City and County have adopted stormwater regulations in response to requirements were mandated by the Environmental Protection Agency (EPA) as part of implementing Phase II of the Clean Water Act. These regulations were adopted by the City in 2007 and the County in February, 2010. Within each set of regulations there are two components – (1) stormwater management standards and (2) stream buffer standards.

Stormwater Management

The adopted regulations of both the City and County address the issue of water quantity and water quality that leave a development site. The adopted regulations specify that the volume of post-development runoff cannot exceed that which left a site during its pre-development state. This means that in many instances new developments require significant on-site detention and filtration facilities. Previous regulations allowed storm water to be discharged directly into creeks.

Under the City's stormwater regulations, subdivisions preliminarily platted prior to September 2007 are exempt from the new regulations; however, all future subdivisions must comply. The goal of the new regulations is to mitigate flooding, erosion, pollution of streams, and personal property damage caused by development activity.

The application of the stormwater buffer requirement is not universal. Within the City of Columbia, properties that were subdivided or had an approved preliminary plat prior to the ordinance adoption date of January 2, 2007 do not need to comply with the buffer requirements. In Boone County, subdivision and projects approved prior to April 30, 2009 do not need to comply with the County buffer requirements. Map 2-xx shows the applicability of the City's stormwater regulations.

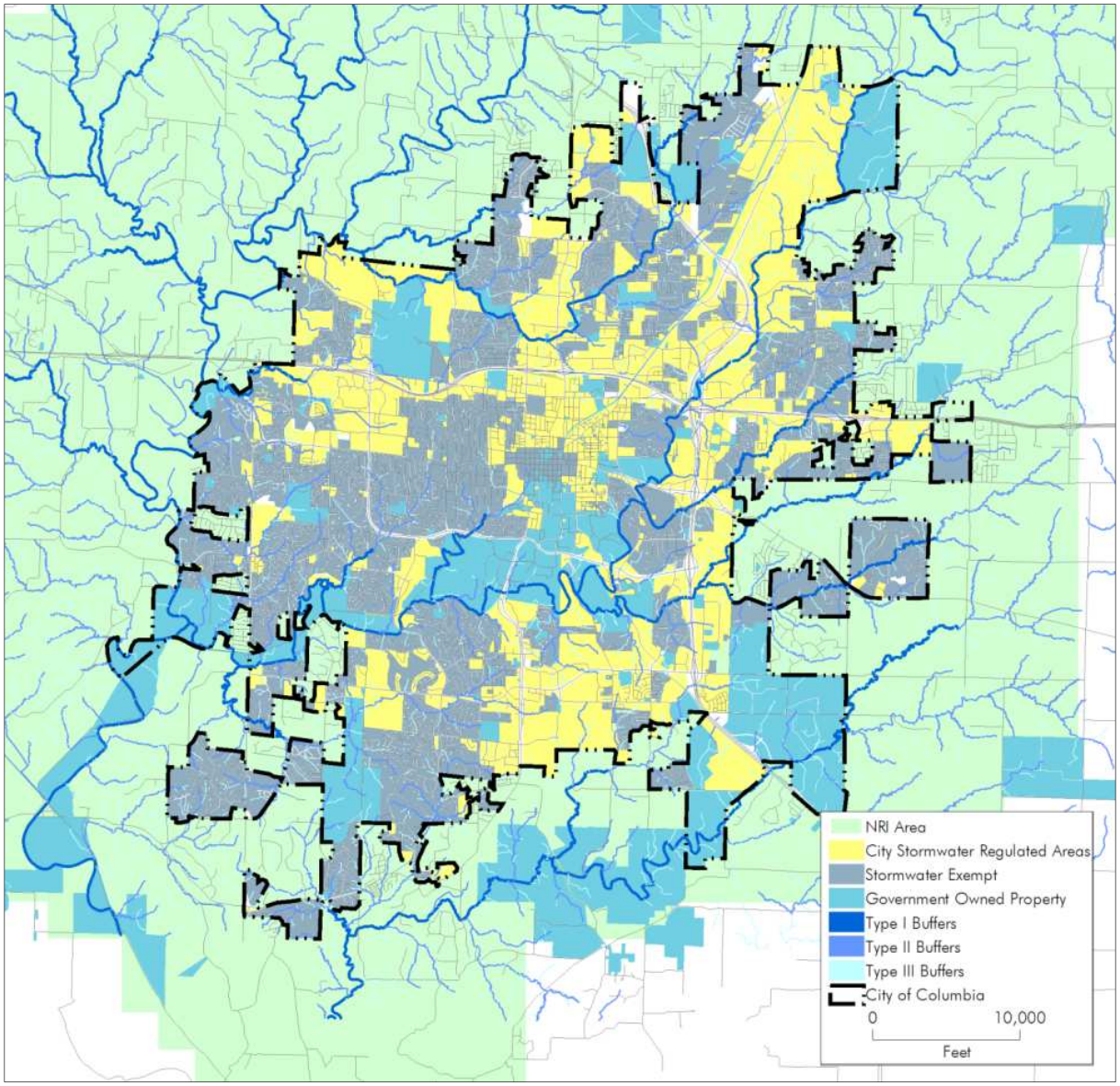
Stream Buffers

A major component of the City and County storm water regulations is the stream buffering requirements. Stream buffers are natural vegetation areas that serve as boundaries between disturbed land and local waterways. They act as filtration systems for storm water runoff entering creeks, thereby protecting aquatic habitat. Stream buffers also stabilize stream banks, mitigate flooding, and preserve natural areas that serve as vital habitat and corridors for the movement of land animals, including people. Stream buffers are measured from the ordinary high water mark and vary in width depending on stream type.

There are three regulated stream types identified in the City's and County's regulations:

Stream Type	Description	Total Buffer Width (each side)
1	Perennial: Solid blue line on USGS map	100 ft
2	Intermittent: Dashed blue line on USGS map	50 ft
3	Ephemeral: Minimum catchment area of 50 acres	30 ft

Map 2-xx - Applicability of City of Columbia Stormwater Regulations



Source: Boone County Assessor and City of Columbia NRI

Stream buffers are expanded to include slopes greater than 15% that are adjacent to outer buffers. County regulations include a 200-foot buffer from karst features such as sinkholes. The inner half of stream buffers must be left as undisturbed natural vegetation. In the City, but not in the County, accessory structures such as sheds may be built within the outer half of these buffers. Trails and maintained lawns may be situated within the outer buffer.

Landscaping

As part of the City's zoning ordinance (Chapter 29) landscaping and screening standards exist. These provisions are intended to:

- Establish healthy environmental conditions by providing shade, air purification, oxygen regeneration, groundwater recharge, storm water runoff retardation, erosion control, and noise, glare and heat abatement.

- Provide visual buffering from streets, to buffer potentially incompatible land uses and to generally enhance the quality and appearance of a development site, and the city in total.
- Encourage the preservation of existing trees and vegetation.
- Supplement the land disturbance permit requirements.

In general the landscaping standards apply to all new development and new parking lots exceeding a minimum threshold size. There are several exclusions to the landscaping requirements which are explained in Section 29-25 of the zoning ordinance.

Tree Preservation

The City requires 25% percent of climax forest to be preserved on tracts of one acre or more. The County has no specific tree preservation ordinance; however, with the recent adoption of the County's Stream Buffer regulations there exists an opportunity to implement the first ongoing regulation to have any direct effect on tree preservation.

In general tree preservation has been most effective on unsubdivided parcels greater than one acre inside the City limits. This is the result of the City's requirement that a tree survey be conducted to determine what climax forest exists on a site prior to land clearing activities. The ability to preserve trees once property is platted is challenging since most residential lots are less than the required one acre minimum size for a tree survey.

Greenbelt/Trail Plan (2002) and Trails Master Plan (2010)

The Metro Greenbelt/Trail Plan (2002)[vii] and Trails Master Plan (2010 revision are elements of the Parks, Recreation and Open Space Master Plan.[viii] These plans describe the desired future network of greenbelts and greenbelt-trails, as well as strategies for the management of these areas.

Bonne Femme Watershed Plan

The Bonne Femme Watershed Plan (2006) is a plan for the long-term viability of the watershed, which includes a portion of far south Columbia (Route K east of KK; as far north as Grindstone Parkway/Route AC).[ix]

Integrated Resource Plan

The Integrated Resource Plan (2008) is Columbia Water and Light's planning document for both supply and demand-side management of the power production and distribution system.[x]

Renewable Energy Policy

Passed by a vote of Columbia citizens (2004), the City's renewable energy policy sets a progressively higher target for percentage of Columbia energy produced with renewable sources. The City is currently required to generate or purchase two percent of electric retail sales in renewable energy sources; this will escalate to five percent by the end of 2012 and 15% percent by 2022 (the 2% minimum was met and exceeded in 2010). The State of Missouri voters have approved a similar renewable energy initiative.[xi]

[i] Natural Resources Inventory – Internal Summary Report, City of Columbia, Missouri, October 13, 2009.
[ii] http://en.wiktionary.org/wiki/stream
[iii] Prime and other Important Farmlands (IA) – Boone County, Missouri. Web Soil Survey – National Cooperative Soil Survey. USDA - Natural Resources Conservation Service. P. 1, 2/25/2010.
[iv] Prime and other Important Farmlands (IA) – Boone County, Missouri. Web Soil Survey – National Cooperative Soil Survey. USDA - Natural Resources Conservation Service. P. 2, 2/25/2010.
[v] http://northernwoodlands.org/articles/article/what_is_a_climax_forest/
[vi] http://www.gocolumbiamo.com/Maps/NaturalResourcesInventory.php
[vii] http://www.gocolumbiamo.com/Planning/Plans/Trails/index.php
[viii] http://www.gocolumbiamo.com/ParksandRec/Master_Plan/documents/trails_plan_2010.pdf
[ix] http://showmeboone.com/ResourceManagement/
[x] http://www.gocolumbiamo.com/WaterandLight/Documents/IRPfinal.pdf
[xi] http://www.gocolumbiamo.com/WaterandLight/Documents/RenewReport2011.pdf